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THE VETERINARY JOURNAL

A MONTHLY REVIEW OF VETERINARY SCIENCE

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EDITOR:

PROF. SIR FREDERICK HOBDAY, C.M.G., F.R.C.V.S., F.R.S.E.

DR. MED. VET. h.c. (ZURICH),
HONORARY VETERINARY SURGEON TO HIS MAJESTY THE KING,
OFFICIER DU MÉRITE AGRICOLE (FRANCE),
CAVALIERE DEI SS. MAURIZIO E LAZZARO (ITALY),
HONORARY MEMBER OF THE AMERICAN VETERINARY ASSOCIATION,
PRINCIPAL AND DEAN OF THE ROYAL VETERINARY COLLEGE, LONDON.

SUB-EDITOR:

GLADSTONE MAYALL, M.R.C.V.S.

with the collaboration of

E. C. AMOROSO, M.D., D.Sc., PH.D.
RICHARD HUDSON, F.R.C.V.S.
PROF. J. McCUNN, M.R.C.V.S., M.R.C.S., L.R.C.P.
PROF. W. C. MILLER, M.R.C.V.S., F.R.S.E.
LT.-COL. T. DUNLOP YOUNG, O.B.E., D.V.S.M., M.R.C.V.S.

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AUGUST, 1936.

CONTENTS.

BIOGRAPHY— PAGE

Mr. John Willett, M.R.C.V.S. ... 277

EDITORIAL—

The Forthcoming N.V.M.A. Congress ... 278

The Value of Exchange Literature ... 278

GENERAL ARTICLES—

On the Scientific and Practical Value of Ionisation in Ophthalmology. Recent Advances and Researches.
By Dr. Gustav Erlanger ... 280

A Preliminary Note on the Life History of *Schistosoma Turkestanicum* Skrjabin, 1913.
By C. MacHattie, F.R.C.V.S., D.V.S.M. ... 291

CLINICAL ARTICLES—

Anthrax in Foxhounds: Note on two Cases in Palestine.
By M. Bergthal ... 299

An Interesting Case of Fœtal Resuscitation.
By S. F. J. Hodgman, M.R.C.V.S. ... 301

Poisoning in a Pig by Hemlock (*Conium Maculatum*).
By J. L. Buckingham, M.R.C.V.S. ... 301

Whey Treatment in Open Joint.
By W. A. Campbell, M.R.C.V.S. ... 303

NEWS ... 304

PLATES—

Mr. John Willett, M.R.C.V.S.
(*Frontispiece*).

On the Scientific and Practical Value of Ionization in Ophthalmology.
(*Article by* Dr. Gustav Erlanger).

A Preliminary Note on the Life History of *Schistosoma Turkestanicum* Skrjabin, 1913.
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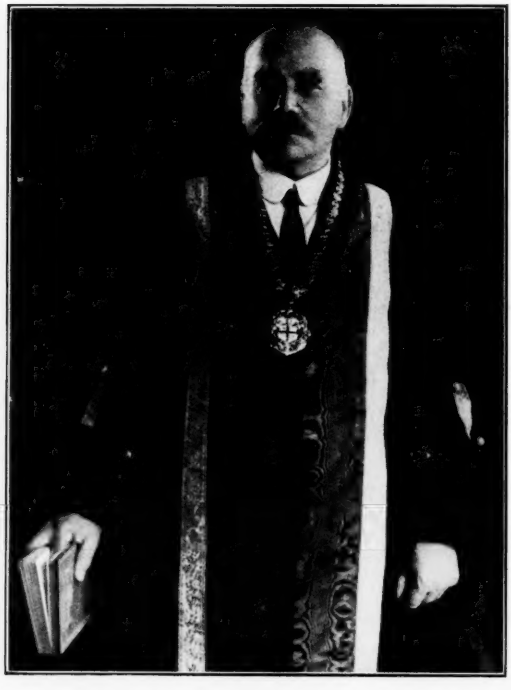

Mr. JOHN WILLETT, M.R.C.V.S.
Honorary Veterinary Surgeon to H.M. The King.
President Royal College of Veterinary Surgeons, 1936–1937.

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GLADSTONE MAYALL, M.R.C.V.S.

in collaboration with

DR. E. S. AMOROSO
Lecturer in Histology and Embryology, Royal Veterinary College

RICHARD HUDSON
Retford

PROFESSOR J. MCCUNN
Professor of Anatomy, Royal Veterinary College

PROFESSOR W. C. MILLER
Professor of Animal Husbandry and Dietetics, Royal Veterinary College

LIEUTENANT-COLONEL T. DUNLOP YOUNG
Veterinary Adviser to various Overseas Governments; late Chief Veterinary Officer to the Corporation of the City of London

AUGUST, 1936

Biography

MR. JOHN WILLETT, M.R.C.V.S.

IN October, 1918, the Editor of THE VETERINARY JOURNAL (who was then serving with the British Army in Italy) received from England the interesting news that his London colleague, Mr. John Willett, had been appointed to join him in the honour of being gazetted, in the Master of the Horse Department of the Household, as an Honorary Veterinary Surgeon to His Majesty King George V. The news was much welcomed, and in the November issue of that same year there appears a photograph of Mr. Willett (as he was then—vigorous and not uncomely), together with a personal page of biographical details.

In this issue we again publish a photograph—mellowed by the intervening years, but still the same features—and on this occasion his name is honoured not only by the recent Royal Appointment to the Household of His Majesty King Edward VIII, but also by the added dignity given by his unanimous election to the highest dignity the profession can offer—that of President of the Council of the Royal College of Veterinary Surgeons.

XUM

Born of veterinary stock and brought up in a very old-established general practice at Staines, Mr. Willett graduated from Edinburgh in 1896, and eventually settled down in the West End of London, where he soon built up a large *clientèle* amongst the owners of horses and dogs, being known amongst his brother practitioners as "my honourable opponent."

His social activities on behalf of the profession include the Presidentship of the Central and Royal Counties branches of the National Veterinary Association respectively, and a very sympathetic interest in the Victoria Veterinary Benevolent Fund.

In wishing him good health to enjoy his recent honours we are sure that we are echoing the voices of all his numerous friends and acquaintances in the profession.

Editorial

THE FORTHCOMING N.V.M.A. CONGRESS.

THE Annual Congress of the National Veterinary Association, always one of the most successful veterinary gatherings of the year, assembles next month at Scarborough, where its members can rest assured of a warm Yorkshire welcome.

The President always looks forward to this termination of his year of office as the final effort of a strenuous year, and it is always the duty of the members to support a President who has given time and energy, to say nothing of the out-of-pocket expenditure, on their behalf; and our President Robert Barker has been no exception to the rule.

Let us therefore be there in person to support him right up to the last in his Chair of Office, and to enjoy for ourselves that post-graduate tuition which is afforded by the unselfish efforts of those who provide essays and demonstrations for the benefit of their fellow men.

THE VALUE OF EXCHANGE LITERATURE.

THAT exchange of ideas is a good thing cannot be denied, and the articles from other countries' periodicals which we place before our readers from time to time in our monthly issues are definite evidence of this and a great encouragement to laboratory workers and clinicians on this side of the Atlantic.

XUM

Our specialists are few, and the facilities for the veterinary consultant are almost infinitesmal as compared with those of the practitioner of human medicine. At the same time, with us, the opportunities for work are great and only want grasping.

The two papers in this issue: the one on the "Scientific and Practical Value of Ionisation in Ophthalmology," by Dr. Gustav Erlanger, of New York, and the second one on the "Life History of *Schistosoma Turkestanicum*," a parasite whose life history has been worked out by Professor Skrjabin, of Moscow, and our British colleague, Mr. C. MacHattie, F.R.C.V.S., are illustrations.

Each article is worth careful reading, not only for the light they throw on certain particular ailments, but for the methods of detail which are so necessary and valuable to research workers as an aid to the solution of other problems.

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General Articles

ON THE SCIENTIFIC AND PRACTICAL VALUE OF IONISATION IN OPHTHALMOLOGY.

Recent Advances and Researches *

By Dr. GUSTAV ERLANGER

New York.

IONISATION—the introduction of drugs and electrolytes into the tissues of the human body or into those of the body of animals with the aid of a weak direct current—plays an important rôle in recent medical literature. This method has been studied especially in ophthalmology. And here its great therapeutic effect may be explained either by experiment or by clinical experience.

The pharmaco-dynamic effect of the current plus the electrolyte consists in a sudden alteration of the permeability of the tissues and with it also of the surface tension. We fix the electrolytes somewhat longer to the cells: we are able to irritate the sympathetic and the parasympathetic nerves with this method in a better way, and we may change the circulation in a sense which is favourable to the restoration of normal or nearly normal functions.

Another feature in adopting this method systematically is the possibility of introducing, especially into the tissues of the eye, in a new way, the so-called urticariogenous group, such as histamine, acetylcholine, and so on. This method has a specific effect on the vessels, and with ionisation these substances can be introduced directly into the tissues, whilst by injecting them subcutaneously there is no guarantee that they come in a sufficient quantity to the site of the lesion.

The technique of ionisation nowadays is very simple. We use an apparatus called Sanion, which contains four pocket batteries, an exact milliampèremeter, a socket and a switch. The wires go to a hand-electrode, which can be provided either with a capsule or with another wire to be connected with a metal tube. The capsule must be filled up with cotton-wool soaked in fluid. The tube must be fixed at the top with a piece of cotton-wool, which one may form corresponding to the size of the ulcer or the focus one is going to treat. The switch is put to the first position. If the patient touches the eye with the filled and wet capsule the current is closed. To have more intensity of current, the switch has to be turned to position two or position three. To avoid sensations, let the capsule be brought near the eye from the touched skin.

In using the tube the physician takes it into his hand and puts it on the cornea or the sclera or the lids, after having placed the hand-electrode in the hand of the patient.

* Reprinted, by kind permission of the Editors, from *The British Journal of Ophthalmology*, April, 1936.

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We need only small intensities of current. To obtain therapeutic results when using the capsule, intensities from 1–2.5 milliampères, time 3, 5 or 10 minutes when using the tube ; intensities from 0.5–2 milliampères, time 0.5–2 minutes are sufficient.

It may be mentioned here that in the past year we used activated solutions with the best effect. The common solutions of electrolytes may be used, but a better effect is afforded by the activated Sanion-solutions, because they are provided with catalysators. These catalysators give no trouble at all to the effect of the ionisation, and are proved to increase the therapeutic effect in the cells and in the tissues.

To prove the efficacy of ionisation, we mention some of the experiments on the eyes of rabbits and of guinea-pigs. In experimental work we use the dose of 3 milliampères for 3 minutes. For instance, can we produce from the *positive* pole with adrenaline (1 : 1,000) a mydriasis of about 11 mm., which lasts several hours? When we take a solution of adrenaline 1 : 1,000,000 we may produce this mydriasis 45 minutes after the ionisation. At any rate, we have an effect on the pupil with even highly diluted solutions with this method.

The ionisation has not only an effect in the tissues in which the drugs are migrating ; it changes, also, the whole circulation, as can be proved by measuring the intra-ocular pressure. In general, there is an increase of the intra-ocular pressure directly after ionisation, even after introducing pilocarpine and eserine. This increase of the intra-ocular pressure is followed by a decrease, which sometimes assumes a diminishing of the pressure by 5–8 mm. Hg. Another proof that the circulation of the eye is influenced : if we inject intravenously 5 c.c. of a 5 per cent. solution of fluorescein (into the vein of a rabbit's ear) and we perform ionisation five minutes later, for instance, of sulphate of zinc on the cornea, the whole anterior chamber is filled up with the stain after some minutes. Normally, there is only a thin line of flourescein from the upper part of the pupil down to the bottom of the anterior chamber, the line of Ehrlich.

That there is also a specific effect on certain tissues can be proved by the following experiment : In introducing chloride of barium (1 per cent.) from the *positive* pole to the eye of a guinea-pig, we always produce a cataract, beginning immediately after the ionisation, and forming within forty-eight hours a total cataract, whilst the cornea remains clear. The effect of the barium can only be overwhelmed by iron when introduced together with the barium by ionisation. Fig. 1 shows clearly the cataract. The section (Fig. 2) shows a normal eye of the guinea-pig, whilst the section (Fig. 3) shows the homogeneous change of the lens, the total cataract.

With this experiment we could study the problem of avoiding a cataract. It seems that thyroxin subcutaneously injected (1 c.c.) before the ionisation with barium, has a certain influence in preventing cataract. Some sections of eyes in this experiment show an enormous dilatation of the vessels of the choroid which one never sees in any other condition. So that we may say that by changing

XUM

the circulation with the aid of thyroxin, which we bring also by ionisation in a larger quantity into the eye, the oxidation of the eye is augmented, so that the barium is unable to alter the lens. All these experiments must, of necessity, lead to a new study of the question of cataract.

If we introduce into the eye of a rabbit a solution of hydrogen peroxide (1 per cent.) from the *positive* pole, we may produce, in some cases, a real megalocornea, with a diameter of the cornea of 12 mm. instead of 8 mm., with a low pressure of about 8 mm. after some 14 or 20 days (Fig. 4). In one case we saw after ionisation bubbles in the anterior chamber. Bubbles of oxygen ? These bubbles could be produced otherwise when we made a puncture of the chamber after the ionisation.

All these above-mentioned experiments prove that the method of ionisation is a method of great pharmaco-dynamic effect, worthy of being studied, and when modified, also of great therapeutic value.

For fifteen years we had the opportunity of seeing many dogs with severe diseases of the eye. In applying ionisation by different methods to these diseases we could study its great therapeutic value. There is no doubt at all that this method is superior to any other method up to the present. We saw cases treated with all known means, and without any avail. The very moment of using ionisation the pathological picture changed. Let us see, for instance, such a picture as keratitis in distemper with a perforation and prolapse of the iris (see Fig 5). The conjunctiva is suppurating ; after some days the cornea is affected, becoming opaque ; there is loss of epithelium, an ulcer is forming, and suddenly the ulcer perforates. The iris is attached to the cornea. A certain vascularisation is evident after some time. The cornea remains cloudy, the iris is attached to the cornea in spite of the use of atropine. We begin treatment after anæsthesia with cocaine 2 per cent., or pantocain 1 per cent., with 0.25 per cent. sulphate of zinc with some drops of adrenaline (1 : 1,000), 1 milliampère, 1–2 minutes. The next day there is a change in the appearance of the eye. The vessels of the livid vascularisation are spreading in the direction of the hole in the cornea. The second treatment consists in applying calcium chloride 0.5 per cent. with drops of adrenaline to the whole cornea. So we change calcium with zinc, always with adrenaline. At the end of a week we have quite another system of vascularisation, the cornea is transparent, the iris has been drawn back from the cornea, and we have a round pupil again (see Fig. 6). The vascularisation consists of a few vessels only, which provide the cornea with better nutrition, for the vessels look quite red instead of the livid colour of the former vascularisation. With the aid of zinc we secure the progress of the growth of epithelium ; with adrenaline we exercise an irresistible traction on the iris ; with the frequent application of of calcium we sensitise the sympathetic nerve so that we get an active hyperæmia instead of the passive hyperæmia which makes only a congestion of vessels and produces that livid ring of vascularisation. It is impressive to observe how only a few vessels are necessary for the healing of a big ulcer, so that the cornea again

FIG. 1.

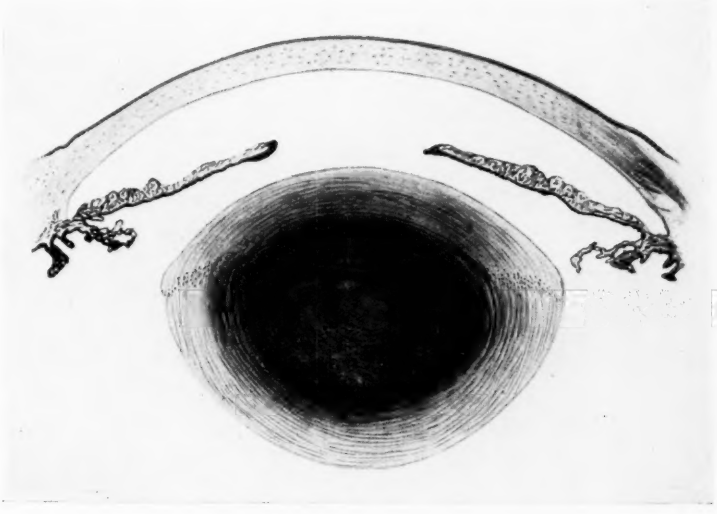

FIG. 2.

(*Article by* Dr. Gustav Erlanger, *page* 280)

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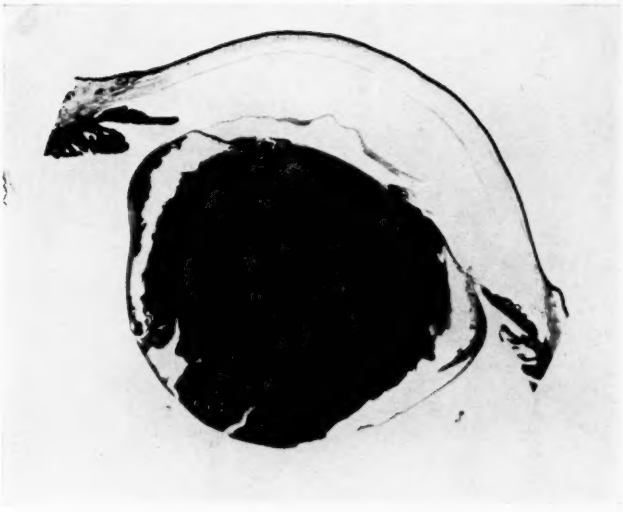

FIG. 3.

FIG. 4.

(*Article by* Dr. Gustav Erlanger, *page* 280)

XUM

FIG. 5. FIG. 6.

FIG. 7.

(*Article by* Dr. Gustav Erlanger, *page* 280)

XUM

FIG. 8.

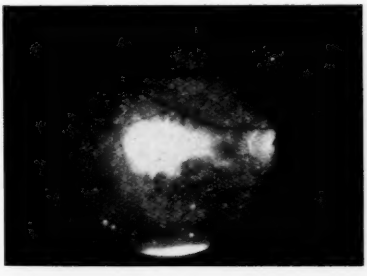

FIG. 9.

FIG 10.

(*Article by* Dr. Gustav Erlanger, *page* 280)

becomes transparent. We see here the confirmation of a real biological law: minute irritation leads to an ideal restoration of the severely damaged cornea. This restoration is even possible in spite of the continuing suppurative exudation of the conjunctiva. There is no possibility any more of infection of the cornea, so great is the effect of the method on the resistance of the tissues. All the cases were treated without any bandage.

From an experimental point of view we tried to treat some cases of staphylomata of the eye, which we saw by chance. Such dogs are otherwise killed by the veterinary surgeon. It was astonishing to observe the vascularisation migrate to the top of the staphyloma. The cornea cleared up, and at the end of a week a prolapse of the iris appeared. After some ten days this disappeared and a round globe developed out of the former staphyloma (see Figs. 7 and 8). Such a therapeutic effect is really convincing, and no scepticism is any more permissible.

With the above-mentioned method we could in every acute case of perforated cornea bring back into the anterior chamber the prolapsed iris, in most of the cases even with a free moving pupil. But also in old cases of iris prolapse we had a good result. We mention the case of a dachshund which had a subconjunctival prolapse of the whole of the upper part of the iris. After ten treatments the iris was completely in the anterior chamber. The cornea, which had a hunch in the upper part, became quite clear and normally curved; the irritation of the eye which had existed several months had ceased altogether. One year later the eye was in the same good condition.

From all these experiences, experimental and clinical observations, the idea developed to study such a method systematically in the treatment of various diseases and pathological changes in the eyes of human beings. And also in this field the method of ionisation brought new and interesting results. There existed already a good deal of scientific literature, especially of an ophthalmological character, with reports of interesting therapeutic results. We mention the papers of Wirtz, 1908, and Schnyder, 1919. These authors confined their iontophoretic work to but a few diseases. The results were worth taking into account, but scepticism arose and the method was only performed by a few ophthalmologists. Bos published a larger paper on ionisation in 1929. He reported on the results in treating ulcers of the cornea, further on the result with ionisation of atropine in cases of iritis. His results were better than with the usual methods. His chief, Dr. Rochat, the director of the eye clinic of the University Groningen, gave new communications on this subject in the International Congress of Ophthalmology in Amsterdam, 1929. A condensation of my work was given by me in Amsterdam, and in 1932 in a pamphlet in the *Jahreskurse für ärztliche Fortbildung*, J. F. Lehmanns, Verlag, München.

But even since that time the systematic ionisation of some new drugs led to the extended application of the method in the diseases and changes of the posterior part of the eye—the results in these diseases are of the most remarkable significance.

XUM

Indications.—Besides the usual therapy, the conjunctiva may be treated in cases of acute inflammation with iontophoretic introduction to the everted lids. Zinc sulphate is to be applied to the tube, 0.25 per cent., 1–2 milliampère, 1–2 minutes. In chronic cases the application of a mixture of calcium chloride and zinc sulphate is of better avail. The dose is the same as before. Calcium chloride, 0.5 per cent., zinc sulphate, 0.25 per cent., *ana partes.*

The follicular conjunctivitis reacts very well and very quickly to the application of calcium chloride 0.5–0.25 per cent., 1 milliampère, 2–3 minutes. Nümi, a Japanese author, gives iontophoresis with a solution of 25 per cent. of calcium chloride. He reports very good resuits (see *Klin. Monatsbl. für Augenheilk.*, April, 1935).

The different kinds of catarrhal ulcers of the cornea are a proof of the strong influence of the ionisation. With the tube one touches the ulcers and the surroundings. Zinc sulphate with one or two drops of adrenaline, 1–1.5 milliampère, 1–2 minutes. Sometimes a small vascularisation is developing which disappears shortly afterwards. After some ionisations with zinc, calcium with two drops of adrenaline is to be applied.

As to the ulcus serpens corneæ, we have seen very good results with ionisation of optochin 1 : 600. Dose 1–1.5 milliampère, 1–2 minutes. In severe cases it is necessary to treat the ulcer twice a day. If optochin is lacking one can use a mixture of zinc sulphate with quinine chloride, to which solution is added one drop of adrenaline. Zinc 1/400, quinine 1/200, *ana partes.* Dose the same as above.

The scars after ionisation with this means are much more transparent than those obtained with any other method. Bos, Arruga and Malkin report similar good results. Arruga alleges that the bactericidal effect of optochin, for instance, is due to the fact of optochin migrating into the depths of the tissue, an opinion which corresponds to all of our reported observations.

The effect of epithelialisation of zinc is shown best in cases of herpes of cornea. After some treatments with zinc every day, the loss of epithelium diminishes and the final vision is much better than with every other method. In herpes and all sorts of neurotic disturbances only one thing is important : no large dose ; 0.5–1 milliampère, 0.5–1.5 minutes. When four or five treatments with zinc have been performed, calcium should be taken ; also with the capsule, 3–5 minutes, 1 milliampère.

The rare keratitis disciformis can be wholly cured with the ionisation of zinc in a very short time. In a paper in 1922 I stated that I could heal such a keratitis in less than three weeks, with nearly normal vision. Fuchs says in his text-book of ophthalmology about keratitis disciformis : " The course is protracted, as it takes one or more months for the eye to become free from congestion and for the infiltrate to be transformed into a corneal opacity which is permanent."

The post-operative infections of the flap in Elliot's operation can be cured, sometimes in one sitting, by ionisation with zinc sulphate 0.5 per cent. We use the tube, 1.5 milliampères, 2 minutes.

XUM

Very impressive is the therapeutic effect of the method in all cases which last months and months without any reaction to other therapeutic methods. We have seen sufficient cases to be convinced of the method. Let us describe only a few.

A patient was treated more than three months daily in a clinic on account of keratitis ulcerosa. The cornea was sowed over with a multitude of infiltrates when we saw the patient first. After some ionisation with zinc the cornea was free of infiltrates, no irritation at all, and the vision was normal. No further recurrence occurred.

Another patient, a bus driver, suffered six months from a recurrent keratitis with irritation of the iris. After three ionisations with zinc and adrenaline we did not see the patient for three weeks. He came back with a normal eye and told us that he had driven his open car in bad weather directly after the last treatment, because he had no trouble at all. No recurrence.

Two years ago a man came to us. He had been treated in a clinic six weeks. His right eye was blind from old kerato-iritis. His left eye suffered from the same disease. An operation (iridectomy) was indicated as the last remedy. The vision of the highly inflamed eye was 1/30. We performed ionisation with zinc, calcium and adrenaline daily. After the second treatment the vision arose to 1/10. After fourteen days the eye was not any more inflamed, the vision was 1/4, the patient had no trouble with his eye and began to work. To avoid recurrences we treated him with calcium once a week for some months. The patient has been well for two years.

Trachomatous conjunctivitis was, in former times, treated by ionisation with a mixture of zinc and copper. Now we favour a mixture of calcium chloride, 1 : 300, zinc sulphate, 1 : 400, quinine chloride, 1 : 500, *ana partes*, which solution is brought to the everted conjunctiva, 1–1.5 milliampères, 2–3 minutes, every second day. The same solution is applied to the cornea with the tube, but only a small dose, 0.5 milliampère, 1 minute. Very effective also is the solution applied to the closed eye with the capsule, 2–3 milliampères, 3–4 minutes.

In acute cases a Japanese author recommends the ionisation with a 25 per cent. solution of calcium. Nümi uses this solution during 10–15 minutes, 2–4 milliampères. He has seen development of scars after 1–2 weeks. Amongst 55 cases he could cure wholly 39 cases, and 14 cases showed improvement (Report in the *Klin. Monatsbl. für Augenheilk.*, p. 561, 1935).

In 1925 we saw a patient with a large ulcer of the cornea due to a trachomatous infection. This ulcer rose above the level of the cornea and could not be influenced by any of the usual means. We declined cauterisation, proposed by a consultative colleague. The very nervous patient finally gave his permission for the iontophoretic treatment. After three treatments with zinc the ulcer began to diminish in size and colour. After some eight days, instead of the ulcer there was to be seen a thin macula. Vision improved from hand movements to 1/3–1/2. A

XUM

year later the other eye was perforated as the consequence of a similar ulcer and became blind ; this eye not having been treated by ionisation, as our representative did not know the method.

An interesting confirmation of the excellent effect of ionisation is a report of Korrenjewicz, Kiew. He treated one eye with a pannus trachomatosus by ionisation, the other with the same pannus as usual. In the eye treated with ionisation the inflammation ceased surely and rapidly.

Episcleritis and scleritis react well to the ionisation with histamine, 1 : 10,000, or acetylcholin, 1 : 400. The tube is put to the boss, dose 1 milliampère, 1–2 minutes. Treatment every day or every second day.

Infiltrates in tuberculous keratitis can be treated by ionisation with calcium chloride 1 : 300. We use the capsule, 1.5 milliampères, three minutes twice a week for a very long time. A specific treatment is no hindrance. The resorption of the exudates is hastened with proceeding. (Report in the *Zeit. für Augenheilk.*, Berlin, April, 1935. " Especially impressive are the results in myopic opacities of the vitreous and even in tuberculous hæmorrhages.")

A good field for ionisation is the inflamed iris. We cite Rochat, who gave a lecture on ionisation with atropine at the International Congress of Ophthalmology, Amsterdam, 1929. Atropine, 1 : 1,000, is introduced into the inflamed iris, not more than 1.5 milliampères, not more than 2 minutes. No intoxication is possible. The treatment can be repeated every day or every second day without any danger. Rochat asserts that this treatment saved the patients from surgical interference.

We apply to the iris calcium with adrenaline, with the tube, 1 milliampère, 1.5–2 minutes, and in many cases after the treatment get the iris bloodless. When we then instil atropine in the common 1 per cent. solution, we strengthen the effect of the atropine. Sometimes we go with the tube only to the limbus and treat especially those spots where synechiæ are present, because the adrenaline can sever the attached iris from the lens.

In subacute and even *chronic iritis* one should try at any rate an ionisation with calcium first, then with calcium-adrenaline. The first treatment has to be done with the tube, then we combine the tube treatment with a treatment with the capsule. Tube : 1–2 minutes, 1 milliampère ; capsule 5–10 minutes, 1–2 milliampères. It is only this method which in some old desperate cases changed the inflammation all of a sudden and produced sometimes surprisingly good vision.

Here, let us remember, the possibility of intensifying the effect of subcutaneous or intramuscular injections of specific or non-specific means by making five minutes later on the ionisation. In all the diseases of the iris it is often necessary to make such injections. Never forget to make the ionisation *after* the injection.

The influence of silver nitrate, 0.2 per cent., from the positive pole, found experimentally in the rabbit's eye, could be proved. The tension can be diminished after a short time. An acute glaucoma in the dog's eye could be cured in

XUM

one sitting. The intraocular pressure was diminished from 80 mm. Hg. to 25 mm. Hg. Dose : 2 milliampères for two minutes.

Some human eyes with absolute glaucoma were treated in the same manner, with the result that the planned enucleation could be avoided.

In chronic glaucoma we treat the eyes in order to improve the circulation by ionisation with a solution of calcium chloride 1/300, capsule-electrode, 5 minutes, 1.5 milliampères. Our friend, Professor Itoh, from the University Clinic for eye diseases in Chiba, Japan, told us that he obtained good results with ionisation of pilocarpine, 1 : 1,000, in chronic glaucoma. He told us that he had observed that not the pressure changed as much, but that the vision and the field of vision remained at the same condition as in beginning the treatment.

As to the question of ionisation treatment in cataract, the practical part of this question can only be solved in common with the work of many ophthalmologists who are adopting this method. It seems to us that this treatment must consist in improving the oxidation of the lens, which may be done directly and indirectly. Indirectly by all methods which improve the whole circulation, directly by applying with the aid of the ionisation means which are improving the circulation of the whole eye, as eserine salicylate in a solution of calcium (calcium chloride 1/300, with 1–2 drops of eserine salicylate, 0.5 per cent.). We use the capsule, 5–10 minutes, 1–2 milliampères, once a week. We dare not say that this method is able to prevent the final progress, because a very large series of cases must be treated in order to gain a distinct impression of its effect. But of all experience we say the study of treatment of cataract must be done at any rate. We state from the experiment on the guinea-pig's eye that it is possible even in nearly totally non-transparent opacities of the lens to clear up these opacities under certain circumstances. And this observation leads to the conclusion that one day the medical treatment of the cataract will be possible.

The study and the systematic application of the ionisation revealed its great and very often astonishing effect in treating many of the acute and chronic diseases of the eye with following improvement of inflammation, and with it of vision, but the therapeutic effect of the method on the posterior part of the eye was a long time without producing satisfactory results.

The possibility of exercising a therapeutic effect with ionisation on the posterior part of the eye, on the vitreous, the choroid and retina, and even on the optic nerve, was given with the introduction of the so-called " urticariogenous " group. These systematically applied by ionisation are histamine, acetylcholin, doryl, dionin. The effect of these is different only in qualitative aspect. For most of the treated cases the application of histamine, acetylcholin, dionin proved to be satisfactory. In application of acetylcholin we have worked out a new technique.

All these substances are formed in the tissue itself. Feldberg and Schilf have called them " Gewebshormone " (hormones of the tissue). These substances may be produced in the tissue by different stimuli. All these substances are

XUM

working upon the vessels, dilating them and relieving spasm, producing arterial hyperæmia, intensifying the velocity of the blood corpuscles and increasing the flow from the veins. Histamine, besides, produces a marked œdema.

If we introduce such substances by ionisation into the tissue of the eye we imitate a natural process, but with the difference that we may dose it to a therapeutic effect. This therapeutic effect may be got by the circumstance that ionisation fixes the substance somewhat longer to the tissue, so that a prolonged effect is produced. The effect on the retina and choroid is perhaps not a direct one. There may chiefly be reflectory effects, if we dilate the vessels of the conjunctiva and those of the orbit. Another idea is possible :

By introducing these substances into the sclera we sensitise the ganglion cells, which are to be found in the sclera, as Dr. Goldstein, New York, told me, and as has been communicated by Dr. Ernyei (Hungarian Ophthalmological Society, February 16th, 1935). These cells are of sympathetic character, so that the ionised substances have a direct effect on the sympathetic, and with it are always producing a better hyperæmia than the usually applied means.

Very interesting are the communications of Ruhmann, who could show that the ionisation of acetylcholin produces the same micro-capillary picture as an energetic massage. We cannot massage energetically the eye ball, but we are able to make a powerful dilatation of the vessels by the ionisation of the sclera with acetylcholin.

The technique for the ionisation of histamine is very simple. We anæsthetise the eye with some drops of 2 per cent. cocaine or of 1 per cent. pantocain. Then we use the tube with cotton-wool and a solution of histamine (1 : 10,000) and put the tube to the sclera far from the limbus, ordering the patient to look in the opposite direction. It is sufficient to treat the sclera at the temporal and at the nasal side. Dose : 1–1.5 milliampère, 1–2 minutes each site. The treatment can be repeated every day, in severe cases twice a day. If there is any reaction, every second or third day. If there is extensive œdema warn the patient, because it lasts sometimes 5–10 hours. If there is a little hæmorrhage in the conjunctiva, it does not disturb the therapeutic reaction. Dionin (1 : 500) has similar reactions, but histamine is of surer effect.

The technique of acetylcholin-ionisation (1 : 200) has been modified. We can use the capsule, filled up with cotton-wool and with the solution of acetylcholin ; dose : 2 milliampères, 5–10 minutes. To mobilise acetylcholin in the tissue itself and to increase its effect when introduced into the tissue by ionisation it has proved best to use the capsule with a solution of calcium chloride (1 : 300) to which are added two drops of eserine salicylate (0.5 per cent.) ; dose : 1–2 milliampères, 5–8 minutes, from the positive pole. Eserine has the quality, even in the highest dilutions, of preventing the splitting up of acetylcholin by destroying the enterase (Feldberg). After having introduced the eserine with the capsule we take the tube with cotton-wool and acetylcholin (1 : 200) and treat the sclera,

XUM

the temporal and the nasal side, as far as possible from the limbus. Dose: 1–2 milliampères, 1–1.5 minutes each side. This treatment must be done in the beginning every day, then three times a week, and, after having got a result, once every week for a long time.

Generally, it may be said that in every kind of choroidoretinitis, be it of arteriosclerotic, diabetic or any other constitutional origin, the method should be systematically carried out. It is always possible to produce a better circulation, perhaps of the effect of the activated means, an effect which consists first in relieving the spasm of the small arteries. At the very moment of influencing the spasm the circulation is improving and the retina is functioning better. One of the most remarkable signs of improvement is the disappearing of central scotomata for colours. The central vision is improving gradually, as well for distance as for near. That also in the course of such a treatment exudates in the retina are resorbed can be proved by pictures of the fundus, photographed by the Zeiss-Nordenson camera. (See Figs. 9 and 10.) It was a case of arteriosclerotic retinitis. In the macular region a big pigmented patch was to be seen. The vessels from the optic nerve to the macular region disappeared behind an exudate. The vision was 1/25–1/20. Large paramacular scotomata could be demonstrated. After a treatment of more than two months the picture has changed in every way. You see, instead of the patch, a small hæmorrhage, the previously curved vessels are stretched and well filled up, the veins and the arteries which had disappeared behind the exudate are distinctly to be seen. The vision has improved to 1/3, with a weak convex cylinder even to 1/2.

To illustrate the therapeutic effect of the new technique, let us cite some other interesting cases:

Thrombosis of the central vein. After ten treatments improvement of vision from 1/50–1/35 to 5/35. Man, aged sixty-three years. Deep excavation, optic nerve temporal paleness. Vision from 1/35–1/25 with —8.0 D. Sph. excentrically seen, within four weeks to 5/20. Reading was improved from recognising big letters to recognising the smallest letters. Lady, aged thirty-five years, burning of the macula after wandering over a glacier without protective glasses. Vision improved from 1/3 to 5/5, for near from Snellen 3.5 to Snellen 1.5 within ten days (treatment every day). A central scotoma for red and green disappeared after the second treatment. High myopia is without any doubt a good field for this treatment. There are remarkable improvements of vision for distance and near.

That in all these cases the constitutional treatment must be taken in consideration is natural. At home the patients have to instil every night a drop of pilocarpine (0.01/20) for months and months.

In cases of retinitis pigmentosa we combine the ionisation with a diathermic treatment before, 10–15 minutes, 200–500 milliampères. There is no doubt that in some cases a therapeutic reaction is possible. Central scotomata for colours disappear. In one case we saw the field of vision enlarging in a high

XUM

degree : instead of the narrow field of vision an annular scotoma had developed. As I have been told by Dr. Henry A. Barrett, New York, he has seen remarkable improvement of retinitis pigmentosa by the diathermic treatment. In combining the two methods we see a new possibility of helping in this serious disease.

Of many cases of retrobulbar optic neuritis which we have treated we have to report that a certain shortening of the course of the disease is possible if we introduce adrenaline from the nasal side into the globe. We take calcium chloride, 1 : 300, with 3–5 drops of adrenaline (1 : 1,000), and put the tube far from the limbus into the orbit ; dose 1–2 milliampères, 1.5–2 minutes every day. The optic nerve recovers from one sitting to another. In most of the cases, after a week there was normal vision, and operative interference like opening of the sinuses was unnecessary.

Résumé.

The systematic study of the method of ionisation reveals many interesting and new observations of theoretical as well as practical therapeutic character. By introducing certain drugs, all being electrolytes, we are enabled to increase their pharmacodynamic effect and thereby obtain better therapeutic results. The method of ionisation is simple, its technique having been improved by new apparatus and new practical electrodes. Every practitioner in eye work may employ it with ease. We repeat once more : The method is of great therapeutic value in most of the common diseases and changes of the eyes, and when used in the uncommon and rare cases sometimes produces astonishing and very impressive therapeutic results. If used in the early stage of a disease the restoration of the function is complete. But even in chronic cases the method should be tried, since it stops the progress of inflammations, and is a mighty factor in accelerating the resorptive power of the tissues.

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XUM

A PRELIMINARY NOTE OF THE LIFE HISTORY OF *SCHISTOSOMA TURKESTANICUM* SKRJABIN, 1913.*

By C. MACHATTIE, F.R.C.V.S., D.V.S.M.,
Veterinary Vaccine, Serum and Lymph Institute, Iraq.

Schistosoma turkestanicum was first described by Skrjabin (1913) from the branches of the portal vein in local cattle (*Bos taurus*) of the Antic-Ala in the Syr-Darja District of Russian Turkestan.

Marotel (1908) reported the occurrence in France, of a schistosome in a home bred cow which he considered to be identical with *S. bomfordi* Montgomery, 1906. Price (1929), however, points out that the egg of Marotel's schistosome had two spines, one at each end, and the number of testes was sixty. As *S. turkestanicum* is the only schistosome reported from cattle possessing a large number of testes and an egg with a prolongation at each end, it appears probable that Marotel was actually dealing with this species and not *S. bomfordi*. Popov (1926) recorded the presence of *S. turkestanicum* in a cat in Kazakstan. Yamagiwa (1931) described the lesions observed in thirty-three cases in Mongolian cattle, caused by the presence of *S. turkestanicum*. Adult worms were detected in the portal system chiefly in mesenteric veins. He found that the parasite was pathogenic to cattle but not to such an extent as *S. japonicum*. He attributes such differences in pathogenicity between these two species to the decided differences in the number of eggs laid by them.

MacHattie and Chadwick (1932) reported the occurrence of *S. turkestanicum* in Iraq, and Bhalerao (1932) described the morphology of specimens sent to him by the writer. Price (1929) transferred *S. turkestanicum* to the genus *Ornithobilharzia* Odhner, 1912, on the basis of morphological similarity to other species of that genus. Price writes, "The fact that both *O. bomfordi* and *O. turkestanicum* are at present known only from mammalian hosts does not appeal to the writer as being a matter of sufficient importance to justify their retention in the genus *Schistosoma;* in view of the morphological relationship of *O. bomfordi* and *O. turkestanicum* to species occurring in birds, it may be assumed that these parasites, which are of rare occurrence in their mammalian hosts, may be only accidental and facultative parasites of these hosts, and it may be surmised that they are normal parasites in birds of some sort."

The life history is unknown not only of *S. turkestanicum*, but of all the species of the genus *Ornithobilharzia*.

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The writer wishes to express his gratitude to Miss Miriam Rothschild and Dr. H. A. Baylis for guidance in this rather difficult field of research. He is also greatly indebted to Professor Leiper and the Imperial Bureau of Agricultural Parasitology for much help. He thanks Major M. Connolly of the British Museum (Natural History) for identifying snail shells, not only with regard to this paper, but also concerning investigations on the snail host of *S. bovis* of domestic animals, *S. haematobium* of man and a general survey of Iraq snail fauna.

XUM

Distribution in Iraq.

Far from being of rare occurrence in domestic animals in Iraq, *S. turkestanicum* has been found to constitute a serious menace to stock in the southern areas. The parasite can be demonstrated daily in thousands in the slaughter-houses at Amarah, Diwaniyah, Nasiriyah, Kerbela, Hilla, Nejaf and Khanaquin or in any flock visited between Amarah and Basrah, by making a post mortem of the most debilitated sheep or goat. It is, however, in the tribes popularly known as Marsh-Arab and in the rice field areas between Amarah and Basrah that the really formidable infestations occur. Between these towns there are immense areas of permanent shallow water on either side of the Tigris, generally some distance from the river. Not a single specimen of *S. turkestanicum* has been found in Northern Iraq and Iraq Kurdestan.

In the Amarah-Basrah areas about 80 per cent. of sheep, goats, cattle and water buffaloes are infected and about 15 per cent. of horses, donkeys, mules and camels. Man, however, appears to be immune. Repeated examinations of human fæces and urine have been entirely negative, yet the snail host is regarded as edible by Marsh-Arabs. Several pools known to be heavily infested are regularly used by the tribespeople for drinking and ablution. Twenty-nine cats and 256 dogs destroyed at Amarah in accordance with anti-rabies measures were examined with negative results. Eleven domestic ducks and three tame geese which had reached maturity and moved daily in water regularly used by heavily infected sheep showed no trace of infection.

The following wild birds were shot near infected pools :—

Two grey lag goose (*Anser anser*).
One common shelduck (*Tadorna tadorna* L.).
Two pintail (*Anas acuta* L.).
Two Jack snipe [*Lymnocryptes minimus* (Brünn)].
One white fronted goose (*Anser albifrons* Scop.).
Three mallard (*Anas platyrhynchos* L.).
One common heron (*Ardea cinerea* L.).
One white tailed lapwing (*Chettusia leucura*).

All proved negative with the exception of a common teal (*Anas crecca* L.) found to be infected with a *Bilharziella* which Professor R. T. Leiper, who kindly examined photographs of the material, considered to approach closely *B. yokogawai* (Oiso, 1927).

Pathogenicity.

S. turkestanicum does not appear to exercise any very harmful effects on the large domestic animals, but in sheep and goats the very heavy infestations which are prevalent in certain areas are of serious pathogenic importance. Such animals are persistently badly nourished and defy all attempts at fattening.

The liver, portal system and intestinal mucous membrane are chiefly affected, the liver being rendered progressively functionless by a deposition of fibrous tissue. Macroscopically cross sections of the liver (Plate Fig. 1) may give an impression of " pipe-stem cirrhosis," while microscopically the liver may show

FIG. 1.

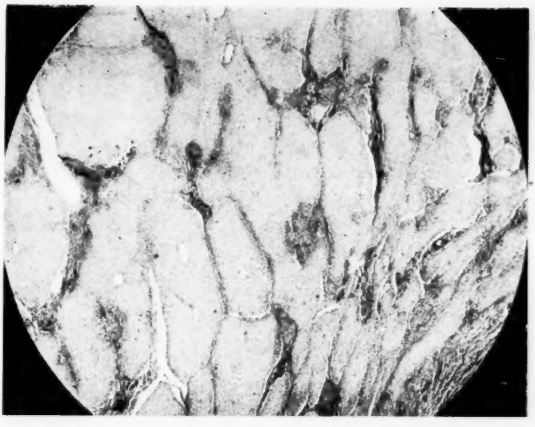

FIG. 2.

FIG. 3.

FIG. 1.—Cross section of a goat's liver showing thickening of vessels.
FIG. 2.—Advanced cirrhosis of liver in a sheep, directly and indirectly due to *S. turkestanicum*.
FIG. 3.—A typical nodule surrounding an egg (in liver of a sheep).

(*Article by* C. MacHattie, F.R.C.V.S., D.V.S.M., *page* 291)

XUM

XUM

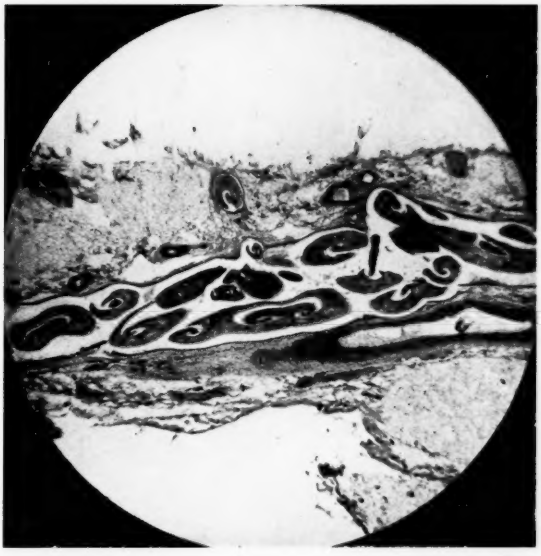

FIG. 4.

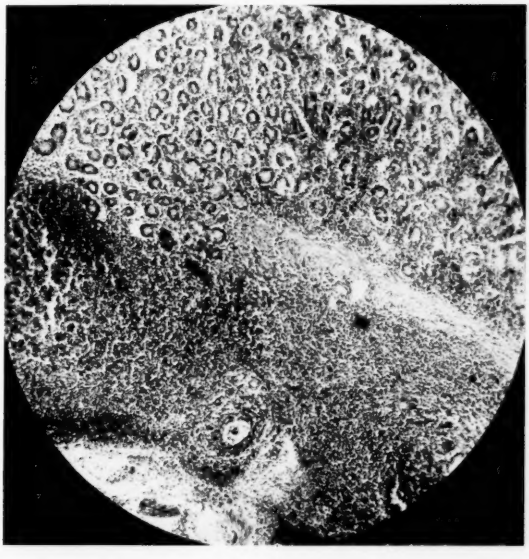

FIG. 5.

FIG. 4.—Longitudinal section of a mesenteric blood vessel (sheep), showing large numbers of the parasite.

FIG. 5.—Nodules in the intestinal sub-mucosa (sheep).

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XUM

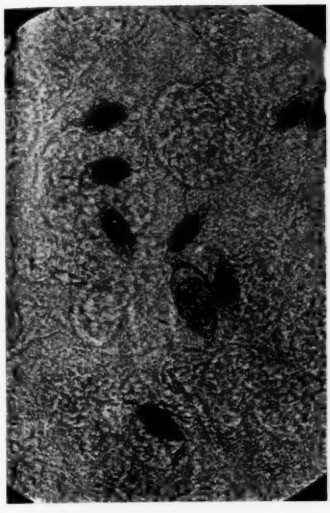

FIG. 6.

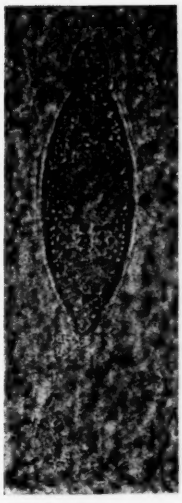

FIG. 7.

FIG. 8.

FIG. 9.

FIG. 10.

FIG. 6.—Mature and immature eggs as shown in scrapings from the mucous membrane of the intestine of a sheep.

FIG. 7.—Immature egg.
FIG. 8.—Mature egg.
FIG. 9.—Male and female.
FIG. 10.—Free female.

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XUM

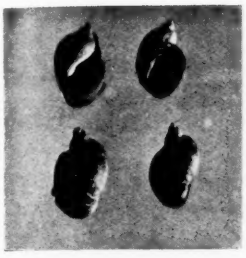

FIG. 11.

FIG. 13.

FIG. 12.

FIG. 14.

FIG. 11.—*Lymnaea tenera euphratica* Mousson ("phase" *Angustior* Mousson).
FIG. 12.—Stained section of liver of an *L. tenera euphratica* infested with *S. turkestanicum*.
FIGS. 13 & 14.—Free swimming cercariæ of *S. turkestanicum*.

(*Article by* C. MacHattie, F.R.C.V.S., D.V.S.M., *page* 291)

XUM

a thick network of fibrous trabeculae (Plate Fig. 2). Cellular infiltration in the neighbourhood of Glissons capsule is also noticeable. Frequently pigment deposition is to be observed and, rarely, thrombosis of a vessel occurs, presumably caused by the organisation of masses of dead parasites. Eggs arrested in the liver tissue give rise to well-defined nodules. (Plate Fig. 3.)

The mesenteric blood vessels of both the large and small intestine appear to be the favourite site of male and female *S. turkestanicum.* In this situation the parasites may readily be demonstrated by holding a loop of intestine to the light. In a heavy infestation several thousand parasites can be washed from these veins. (Plate Fig. 4.)

The characteristic egg is readily demonstrated in material obtained by lightly scraping the intestinal mucous membrane. (Plate Figs. 6, 7 and 8.) Nodules, similar to those in the liver, are formed throughout the length of the intestine by eggs embedded in the mucous membrane. (Plate Fig. 5.)

These lesions of the intestinal wall or " casing " are of considerable economic importance to Iraq. An annual revenue of approximately £60,000 is obtained from the export of animal casings. Baghdad is the collecting point of the trade. At specially constructed establishments the intestines are examined and tested one by one by practised workers, and according to their quality are graded " high " or " low " or are discarded entirely. The casings are graded according to their ability to retain water. Thus porous intestines, known in the trade as " sprinklers " are discarded, and intestines showing patchy thickness are of little value since they are not of uniform strength. Northern Iraq and Iraq Kurdestan produce excellent casings. The Central Iraq product is of medium value, while Southern Iraq casings from certain areas show such a large proportion of " sprinklers," that the trade in these areas is barely a commercial proposition.

An examination of possible reasons shows that the distribution of sites of origin of good and bad casings corresponds to the localisation of schistosomiasis. The injury to the wall of the intestinal tract caused by the deposition of spiny schistosome eggs and reactionary tissue changes, is such that patchy thickening of the intestine is produced.

Proper nutrition of the animal body becomes, with age, a matter of increasing difficulty and the fattening of sheep and goats an impossibility. The total economic loss is great, and is not so much the result of occasional deaths directly due to the parasites, but to the weakening of the animal's constitution which predisposes to deaths on a large scale when periods of drought and food shortage occur.

Morphology.

The Iraq schistosome (Plate Figs. 9 and 10) both in its natural state and artificially bred in experimental animals, would appear to be identical with *S. turkestanicum* Skrjabin, 1913. During the past three years the writer has made a very careful comparison of both smooth cuticled specimens and the tuberculated

XUM

types referred to by Bhalerao (1932)* and has formed the opinion that the false tubercles form the only difference between the types, the tuberculated appearance being due to contraction of the cuticle of the male worm, an appearance only observed when the worm is not killed quickly. The maximum and minimum total length measurements of specimens, from a collection of over 10,000 are: Male, 2 to 10 mm.; Female, 2 to 8 mm.

Specimens from sheep and horses were submitted to Professor Leiper and Dr. H. A. Baylis, who identified them as *S. turkestanicum*.

Natural Injection in the Mollusc Host.

Since *S. turkestanicum* occurred in almost every sheep and goat in the Amarah Marsh-Arab and rice field areas, it followed that the snail host must be a very widespread and prevalent one in that district. Investigations were carried out by the writer in June and December, 1931, June and September, 1932, and May and September, 1933. The infected pools were traced from infected sheep slaughtered at Amarah slaughter-house and the site of infection confirmed by the purchase and postmortem examination of sheep at the water pools so traced.

A thorough investigation of the molluscan fauna was undertaken, and revealed that the most prevalent snail in water used by infected sheep and goats was *Lymnaea tenera euphratica* Mousson.

The other species found were *Bulinus truncatus* Aud., *Corbicula fluminalis* Mull., *Lymnaea canalifera* Mouss., *Melanoides tuberculata* Mull., *Melanopsis nodosa* Fer., *Planorbis philippii* Monts.

In the Baghdad area, where infections of *S. turkestanicum* are comparatively rare, the only host of mammalian schistosome cercariae is *Bulinus truncatus*, which is infected with both *S. hæmatobium* and *S. bovis*; (*S. mansoni* does not occur in Iraq). It was, therefore, of interest to find that in the Amarah area this species of snail was comparatively rare, about one *Bulinus* being found to every 500 *Lymnaea*.

The snails were subsequently examined for larval trematodes. All species other than furcocercous cercariae were considered irrelevant to the present investigation. One specimen of *Bulinus truncatus* was infected with a brevifurcate apharyngeal distome. A few specimens of *Melanoides tuberculata* were found heavily infected with a pharyngeal longifurcate distome with eyespots. *Lymnaea tenera euphratica* harboured two species of furcocercous cercariae. An apharyngeal longifurcate distome occurred in 0.7 per cent. of the snails, and an apharyngeal brevifurcate distome was present in 1.8 per cent. of the snails.

Experimental Infection of Laboratory Animals.

The apharyngeal brevifurcate distome cercariae from *Lymnaea tenera euphratica* were fed to laboratory reared animals. *S. turkestanicum* was recovered from the mesenteric vessels and liver. Details of these experiments are given below.

* All of Bhalerao's specimens of *S. turkestanicum* were collected and preserved by the writer. So far as is known, the worm does not occur in India.

The cercariae from *Bulinus* were also pipetted into the mouth of a white mouse, which subsequently developed a *S. haematobium* infection. The apharyngeal longifurcate distome cercariae from *Lymnaea tenera euphratica* and the pharyngeal longifurcate cercariae from *Melanoides* were likewise fed to laboratory reared rabbits and white mice. These animals were killed three months after exposure to infection, but no schistosomes were found. This result was to be expected, as the cercariae in question displayed characters unlike those of any known mammalian schistosome. However, the morphology of adult *S. turkestanicum* differs so markedly from that of other members of the genus (excluding *S. bomfordi*) that it seemed quite possible that its cercariae might also prove an aberrant form. It was, therefore, considered safer to expose animals to infection from all the species of furcocercous cercariae recovered from the snails.

Details of the Experiments.

In May, 1933, about 4,000 *L. tenera euphratica* were collected and examined at Amarah and the products of 76 snails infected with the cercariae of *S. turkestanicum* were pipetted into the mouths of eight white mice, six rabbits and five guinea-pigs, all bred in the laboratory. Each animal received at least three heavy doses on each of three successive days (9th, 10th and 11th May). Mice showed signs of irritation in the mouth and repeatedly rubbed the mouth with the feet, but no mouth sores were ever detected as the result of passage of cercariae.

The animals were taken to Baghdad where after two months the fæces were examined daily for eggs, but with entirely negative results. After three months the animals were killed, the following results being obtained :—

Mouse 1.—Killed. Three female *S. turkestanicum* were washed out from the mesenteric vessels.

Rabbit 1.—Killed. Eleven female *S. turkestanicum*, six of which showed a rudimentary egg in the uterus, were washed from the mesenteric vessels.

Rabbit 2.—Sixteen *S. turkestanicum*, again all females, were recovered from the mesenteric vessels.

Guineapig 1.—Entirely negative.

Mouse 3.—Killed. From one half of the liver, four males and females in copula were recovered, in two cases the female was lying the wrong way round in the canal. In addition, two free males and one free female were recovered from the liver. Only one female was washed from the mesenteric blood vessels.

In all the above animals no parasites or eggs were found in the lungs, bladder wall, centrifuged urine, preparations of fæces and smears from the intestinal wall.

Experimental Infection of Mollusc Host.

In order to obtain a supply of uninfected *L. tenera euphratica* a collection was made from the Baghdad ditches. (It has already been pointed out that infection of sheep with *S. turkestanicum* is rare in this district). Numbers of

these snails were crushed, but no furcocercous distomes were found, and a batch kept in the laboratory for six weeks under close observation also proved to be uninfected.

Three emaciated sheep from the Chiyala area of Amarah, all heavily infected with *S. turkestanicum*, were sent to the laboratory at Baghdad. On postmortem, scrapings from the mucous membrane of the intestine showed numerous *S. turkestanicum* eggs with and without a developed miracidium. Scrapings rich in eggs and also some passed fæces were added to a jar containing the uninfected *L. tenera euphratica* from Baghdad. The snails readily fed both on the mucous membrane and the fæces. Eighteen days later one of the crushed snails showed a heavy infestation of the liver with mammalian schistosome cercariae. These were morphologically identical with the cercariae found in *L. tenera euphratica* from the pools used by heavily infected sheep at Amarah. Cercariae emerged from three other snails on the twenty-first day, and sixteen out of twenty snails proved to be infected on crushing.

Batches of *Bulinus truncatus*, *Melanoides* sp. and *Melanopsis* sp. collected from Baghdad were exposed in a similar manner to infection with the miracidia of *S. turkestanicum*. Three weeks later, the snails were crushed and dissected but no trace of sporocysts or cercariae were found.

Characters of the Mollusc Host.*

Shells of snails infected with *S. turkestanicum* (Plate Fig. 11) were sent to Mr. G. C. Robson, of the British Museum (Natural History), who submitted them to Major M. Connolly. He identified them as *Lymnaea tenera euphratica* Mousson, " phase " *Angustior* Mousson.†

Both in the natural infections at Amarah and in the experimental infections at Baghdad, the infected *Lymnaea* is always of small size, approximately 12 by 6 mm. Large specimens were never found infected. The " phase " therefore appears to have some significance, and in the writer's experience *L. tenera euphratica* Mousson " phase " *Angustior* Mousson is the only host of the cercaria of *S. turkestanicum*.

The pathological effect on the snail is very marked, although no lightening in colour of the shell occurs, as in the case of *Bulinus truncatus* infected with *S. haematobium* or *S. bovis*. Infected snails placed in tubes never lived more than eight hours and, unlike uninfected specimens, rarely survived transport from Amarah to Baghdad.

Iraq experiences two extremes of climate during the year. May to October is very hot and dry, and, in sharp contrast to this, December to April is cold and wet. With the onset of the cold weather the snail hosts of *S. turkestanicum*,

* No trace of *Barrouxia* parasitation has been recorded in Iraq, either in the case of *Lymnaea* or *Bulinus* species.

† From specimens of *Lymnaea tenera euphratica*, supplied to her by the writer, Marian Rothschild (1936) has described the process of encystment of a cercaria belonging to the heterogeneous Gymnocephalic group.

S. haematobium and *S. bovis* die in thousands. In the rare specimens of *Lymnaea* then found infected, the cercariae are moribund and incapable of effecting penetration. Thus it would appear that stock can drink from infected pools during the winter with comparative impunity.

L. tenera euphratica is common along the banks of the lower Euphrates, but the most northerly record appears to be five miles north of Samara (Annandale and Prashad, 1919). Thus the distribution of *S. turkestanicum* would appear to be closely linked with that of the snail hosts. Other factors, however, such as suitability of environment, probably play an equally important part.

Development in the Mollusc Host.

The Miracidium.—The surface of the body is covered with long cilia except at the protuberant anterior extremity. Two pairs of cephalic glands with large nuclei are present. A portion of the intestine can be traced through the anterior half of the body. When placed in water, the eggshell swells and two large globules of fluid make their appearance, one at the blunt pole and one laterally. By means of the cilia the miracidium rotates the lateral globule of fluid. Pressure is thus increased and probably facilities escape from the egg capsule.

The average measurements of thirty mature eggs containing miracidia were 0·152 mm. by 0·054 mm. (including the posterior blunt process and anterior spine process). The length of the miracidium within the egg was 0·108 mm. by 0·044 mm.

The Sporocyst.—The miracidium develops into a mother sporocyst, giving rise to daughter sporocysts. Eventually the entire liver of the snails becomes permeated. (Plate Fig. 12.) No movement of sporocysts was observed.

The Cercaria (Plate Figs. 13 and 14).—Free swimming cercariae were examined alive and dead in saline and in horse serum as recommended by Archibald and Marshall (1931). Mounted specimens were prepared according to these authors' lacto-phenol-gum technique. Carmine, neutral red and Delafield's haematoxylin were used for intra-vitam staining. Measurements were taken of free swimming forms, killed by heat according to Manson-Bahr and Hamilton Fairley's (1920) technique. It has already been stated that the cercaria of *S. turkestanicum* is a non-eyed apharyngeal brevifurcate distome. The oral sucker or anterior organ is well developed, but the ventral sucker, situated near the posterior end of the body, is only moderately developed. The body, including the surfaces of both suckers, together with the tail and furcae, are covered with fine spines. These are most conspicuous on the tail and furcae. The cuticle is delicate. The penetration glands are variable in shape and position, but there are apparently four pairs of large glands. In the living cercariae the glands appear refractile and glassy, but in stained sections they show a finely granular structure. Two groups each of four ducts run forward along the sides of the oral sucker. At the anterior end of the oral sucker are eight piercing spines, four on each side of the middle line. The glands produce a

fluid which often adheres to the spines at the exit of the ducts, and this makes them difficult to distinguish. A bladder can be seen at the posterior end of the body, but the writer found it impossible to distinguish collecting tubes and flame cells. An excretory duct runs throughout the tail and furcal rami. The tail contains several cells with clear cytoplasm and large nuclei distributed in the parenchymatous tissue.

Measurements of the cercaria in millimetres.—(Average of 30 specimens.)

Body	0·178 × 0·0620 mm.
Tail	0·187 × 0·226 ,,
Furcae	0·045 × 0·013 ,,
Protruded anterior organ	0·019 × 0·0189 ,,
Depth of oral sucker	0·058 × 0·022 ,,
Diameter of ventral sucker	0·017

Behaviour of the Cercariae.—The cercariae are discharged from the snail in puffs of about twenty to fifty, at a temperature varying from 20° to 26° C. Emissions can take place either by day or night, but are most rapid in direct sunlight.

The cercariae did not show the predilection for the sub-surface position in a test tube shown by the cercariae of *S. haematobium*, but were fairly evenly distributed throughout the water. When tubes of free swimming cercariae were covered with black paper into which a small window was cut, there was no noticeable movement towards the light. In the dark, however, many cercariae attached themselves to the sides of the tube, apparently by the oral and not the ventral sucker. In a petri dish of water, under the dissecting microscope it was observed *that the cercariae always progress body-first.* The most characteristic movement is as follows: The tail bends about its middle and the furcae bend round to touch the oral sucker. This movement is made slowly and deliberately four or five times, as if the cercaria was preparing itself for the next movement, which is actually the same looping movement carried out very much more quickly. The movement is always in a semi-circular direction. The cercariae often rest on the bottom of the petri dish as if they were standing on the furcae. Generally in a test tube when at rest they hang in the water with the head downwards. When attached to a foreign body they often lie quiescent and the only movement is a slow writhing of the furcae which can apparently be moved quite independently of movement of the tail stem. Often a cercaria turns a half somersault, quickly attaches itself by its sucker, and again comes to rest. The extrusion of the ventral sucker, so marked in the cercariae of *S. haematobium*, is very rarely observed. There is a very definite protrusion of the anterior organ so that living cercariae observed on a slide often appear as if the body were divided into two parts by a constriction.

When the cercaria is trying to progress under a coverslip, the anterior organ is thrust forward and the anterior sucker attaches itself; then, accompanied

by wriggling of the tail and furcae, the body contracts and is drawn forward. On a slide, body and tail readily separate.

The internal structures of the cercaria are much more difficult to observe and distinguish than are those of *S. haematobium* or *S. bovis*, while considerable difficulty was experienced in watching the movements and behaviour of the free swimming cercariae.

Conclusion.

1. *Schistosoma turkestanicum* is a formidable and dangerous parasite of domestic animals in the Marsh-Arab and rice field areas of Iraq.

2. In addition to cattle, sheep, goats and water buffaloes, it has been proved that camels, horses, donkeys and mules are also hosts.

3. The arrest of the egg in the intestinal mucosa and the consequent formation of nodules largely destroys the value of the intestine as a commercial product.

4. Man and domestic and wild birds are apparently immune to infection despite continuous exposure to the attacks of the cercariae of *S. turkestanicum.*

5. The snail host of *S. turkestanicum* is *Lymnaea tenera euphratica* Mousson (" phase " *Angustior* Mousson).

6. Cercariae of *S. turkestanicum* become very sluggish towards the end of the hot season (late September) and disappear from October to May. It seems probable that live stock can then drink from infected ponds with comparative impunity.

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Clinical Articles

Anthrax in Foxhounds: Note on two Cases in Palestine.

By M. BERGTHAL,

Assistant Veterinary Officer, Government of Palestine.

An outbreak of anthrax occurred amongst the foxhounds of the Ramle Vale Hunt towards the end of the last hunting season. I was requested to make a post-mortem examination on the carcase of one of the hounds which had died after a short illness.

Case No. 1. *History.*—The foxhound was said to have appeared quite fit while hunting and up to the time of its return to kennels. Shortly after eating its evening meal it became ill and commenced to vomit. Great prostration followed, the hound lying motionless with its head hanging over the side of the kennel board. Death occurred shortly afterwards.

Post-mortem.—The post-mortem was conducted twelve hours after death. The hound, a two year old, was in good bodily condition. The carcase was not "blown," but dark-coloured blood was observed to be oozing from the natural orifices. The visible numerous membranes were cyanotic and exhibited petechial hæmorrhages. The abdominal cavity contained a quantity of non-coagulated blood. The spleen was enlarged, blackish-red in colour and soft in consistency, the kidneys were inflamed, showing petechiæ under the capsule. The lymphatic glands of the mesentery and the mediastinal glands were enlarged, infiltrated and contained blood extravasations. The stomach, duodenum and part of the small intestine showed hæmorrhagic inflammation. Hæmorrhagic patches were found on the epicardium, in the region of the coronary arteries, and the lungs were œdematously infiltrated.

Diagnosis.—Anthrax was suspected. Material was submitted to the Government Veterinary Laboratory, but as it did not arrive until the following day, was found useless for microscopical examination, as it had turned putrid. Diagnosis was confirmed by Ascoli's precipitation test and by animal inoculation.

Case No. 2. *Symptoms.*—Two days later another hound became ill. The temperature was 40.3° C., the visible mucous membranes cyanotic and a slight swelling around the throat was observed. Severe prostration accompanied the above symptoms, the hound lying stretched out, motionless, in a state of coma.

Treatment.—Anthrax was diagnosed and 10 c.c. of anti-anthrax serum of the Government Veterinary Laboratory injected subcutaneously. In a few hours a marked improvement was observed. This improvement in condition gradually increased and the following morning the hound was walking about, and by the third day had completely recovered.

The remaining hounds were all injected with anti-anthrax serum as a precautionary measure, and further cases did not occur during the remaining weeks of the hunting season.

Discussion.—It is known that dogs possess a very high resistance to anthrax and that it is very difficult to produce the disease even by inoculation of large doses of anthrax culture. It is observed from perusal of the Report of the Veterinary Research Institute, at Muktesar, India, 1925, that the only certain method of killing dogs was by inoculation of blood rich in anthrax bacilli. The two cases in question can only be explained on the presumption that while the hounds were out hunting they came across an unburied anthrax infected carcase and, having engorged themselves, contracted the disease through some abrasion in the alimentary tract, possibly caused by splinters of bone.

XUM

An Interesting Case of Foetal Resuscitation.

By S. F. J. HODGMAN, M.R.V.S.
Shortlands, Kent.

Subject.—A Dalmatian bitch, six years old.

History.—Being in whelp she had produced one puppy three days before she was brought to me.

Symptoms.—On examination it was apparent that she had not finished whelping, and I estimated that at least two more puppies were present. In my opinion both were dead. The bitch appeared quite bright, but had a temperature of 103°. There was an unpleasant discharge from the vagina and no history of labour pains.

Treatment.—I made a digital examination *per vaginam*, but could not touch anything. I decided to operate, and, as the owner did not wish to breed from the bitch again, I decided that a hysterectomy was the safer operation to perform. This I carried out in the usual way.

From the time that the two horns had been ligatured and removed, to the putting in of the final skin sutures, about twenty minutes elapsed, and during this time I had to stop a few minor hæmorrhages, close the peritoneum, abdominal muscles and skin. The operation being completed, the animal was conveyed from the operating theatre to my hospital, and I went with her to see that she was comfortable, which took another five to ten minutes. On returning to the theatre I thought it might be interesting to see what the tubes contained. I found a dead puppy in one tube, and in the other I found one puppy dead and a second alive. It required very little resuscitating, and is still alive and being reared by its mother.

The remarkable feature of this case is the period of time that elapsed between the severing of the blood supply and the actual freeing of the puppy from the womb and its membranes.

Poisoning in a Pig by Hemlock (*Conium Maculatum*).

By J. L. BUCKINGHAM, M.R.C.V.S.
Halesworth, Suffolk.

THE subject of this case was a pedigree large black gilt about eight months old.

History.—The gilt had been turned out on a piece of rough pasture, and the owner had seen it eating some hemlock during the day. He did not take much notice of this at the time as he did not know the plant was hemlock. When he went to feed the gilt in the evening she did not come up to the trough, but lay in the straw. On being made to rise there was marked trembling of the hind limbs, and the gilt moved with a stiff gait behind.

The diet had consisted of bran, middlings and cow's milk, as well as grass, etc., obtained while out during the day. The gilt, which was bred on the farm, had never before shown signs of illness.

XUM

When we arrived the animal was in an almost comatose condition. The ears were cold, as was the skin. The eyes were closed at first, but opened on being disturbed. Temperature was sub-normal; respirations were accelerated, and there was some dyspnœa. The heart beat also was rapid. The gilt was disinclined to rise, and when made to do so, moved with difficulty; gait, especially of the hind limbs, being weak and staggering, and the gilt soon resumed a recumbent position. There were no signs of the sow having defæcated since coming into the sty.

Diagnosis of hemlock poisoning was based on the above history, and also on the fact that when we looked round the meadow we found hemlock plants, and also parts of plants remaining after parts had been eaten off. Other pigs on the farm, which had not been on this meadow and had otherwise been on the same diet as this gilt, were perfectly healthy. No fresh pigs had been brought on to the farm for some years, and sows had not been off the premises to a boar, as one was kept on the farm. Thus no infectious disease could have been introduced by that channel. Neighbouring premises were free from swine diseases. Also the symptoms pointed to poisoning rather than bacterial or other disease. Prognosis was guarded.

Treatment.—We administered four cubic centimetres of phenolphthalein intramuscularly and applied stimulating embrocation to the hind legs and loins. The following morning the gilt showed signs of improvement. She drank some milk and was stronger on her legs. Acidum tannicum, gr. xx, was administered in the form of electuary, and the embrocation was again applied. By the afternoon temperature was normal, and respirations and heart beat had improved, but the gilt was still unsteady on the hind legs and there were signs of general weakness. Appetite had returned.

The following powders were left as a tonic:

℞	Pulv. ferri sesqui-oxid.	dram 1
	Pulv. cinchonæ rub.	dram 1
	Excipient ad	dram 4
	Fiat pulv xii	

Sig.—One powder to be mixed in the pig's food morning and night.

The owner was told to continue daily massage with the embrocation. The gilt was very weak for the next two or three days, but had completely recovered by the sixth day.

Whey Treatment in Open Joint.

By W. A. CAMPBELL, M.R.C.V.S.

Boroughbridge, Yorks.

SOME three or four years ago I read in a veterinary paper about the use of whey injected into open joints. A few days after reading about it I tried it in an open stifle of a hunter with marked success. Since then I have never thought of using any other treatment for this condition. I have used it in most of the joints of the horse's limb with complete success, with the exception of open coffin joint. The reason why the coffin joint gives so much trouble is because of the difficulty of getting a needle into this joint for injecting. I have tried from the sole, and also from the hollow of the heel above, but I am never satisfied that I hit the joint. Two years ago I had four cases of open coffin joint in the hind foot all on hand at the same time. One died outright, one disappeared whilst still lame, and the other two returned to work after some six months' idleness. Perhaps the best way to describe this treatment is to give the results of a case or two.

A well-bred hunting mare got kicked at exercise by a loose horse. When seen the following morning she was stood, holding her leg up, blowing, sweating, and in great distress. Every time she moved, joint oil spurted right across the box from a deep punctured small wound in her stifle joint. Fresh whey was obtained direct from a local dairy ; about two or three ounces was injected into the wound with an ordinary hypodermic syringe without the needle. In some cases this all disappears into the joint, at other times a good deal escapes immediately you withdraw the nozzle of the empty syringe. Then a needle was plunged right into the joint some two or three inches away from the wound, and six to eight ounces of whey injected. The following morning the mare was very much better : the foot was on the ground, and she was eating well ; the wound was damp, but no sign of oil. Two days after there was a slight trace of oil, and whey was again injected. A week after, the lameness was rapidly disappearing, and within the month she was back in work. A useful steeplechase horse that had won several good races jumped into itself at the last fence when winning a race and tore a front fetlock joint right open. The veterinary surgeon on the course gave a very guarded prognosis, but dressed and bandaged the joint and sent the animal home by road, about a hundred miles. I saw the horse early the next morning. It was a terrible wound : the sesamoids were showing and oil was pouring out. I injected the joint with fresh whey, and laid cotton wool, soaked in whey, over the wound, and bandaged up. Instructions were left that the wound was to be dressed twice daily with fresh whey soaked in cotton wool. This horse made a wonderful recovery, and in less than two months was back in training. To-day, nearly two years after, there is only a small scar with little or no thickening.

About a fortnight ago I was called to a four-year-old cart mare. She had been running joint oil from her hock for three weeks. The joint was very large ;

XUM

the muscles of the quarter were badly wasted, and they had been having trouble to get her up when laid down in the box. She carried the limb. I injected whey into the wound on the outside of the hock, then plunged a needle up to the hilt in the inside of the much-swollen hock, and injected quite eight ounces of whey, then turned her out into a grass field. As the case was a long way from home, a syringe with a short blunt nozzle was left with instructions to inject fresh whey for a day or two. I gave the owner very little hopes of a recovery because of the time lost in treating and the septic condition of the joint. Much to my surprise, on visiting her just a week later, I found her walking about the field, with no sign of oil. The owner told me he used the whey for two mornings, but as the wound appeared to be closed up, he stopped it and just sponged with cold disinfectant and applied the wound powder. If the mare continues to improve as she is doing she will soon be sound, although I doubt whether all the swelling will disappear.

It is a complete mystery to me what action whey can have on an open joint, and especially how rapidly and completely it can close up a fairly large wound in a joint. Since carrying out this treatment I have learned several methods of making whey. I always thought that the addition of rennet was about the only one, but I find that many farmers' wives never use it—some use vinegar, others use alum. I think that whey made with alum is the most effective in this treatment.

News

NEW APPOINTMENTS AT THE ROYAL VETERINARY COLLEGE.

Professor J. Basil Buxton, M.A., F.R.C.V.S., D.V.H., Professor of Animal Pathology, University of Cambridge, and Director of the Institute of Animal Pathology and of the University Field Laboratories, Cambridge, has been appointed by the Governors of the Royal Veterinary College as Acting Principal and Acting Dean of the College as from September 25th, 1936; and to succeed Sir Frederick Hobday, C.M.G., F.R.C.V.S., F.R.S.E., as Principal and Dean on the latter's retirement. Sir Frederick's retirement will not take place until the opening of the Main Block of the new College buildings.

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